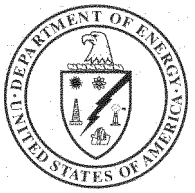
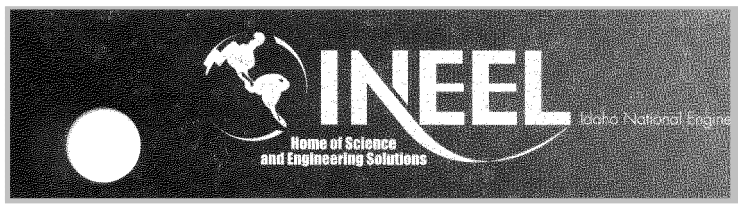
DOE/ID-11094
Revision 0
Project No. 23096

December 2003



U.S. Department of Energy
Idaho Operations Office

Field Sampling Plan for Group 3, TSF-03 Burn Pits for Test Area North, Waste Area Group 1, Operable Unit 1-10



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December 2003

Prepared for the
U.S. Department of Energy
Idaho Operations Office

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DOWID-11094

Approved by

Gary E. McDannel
WAG 1 Project Engineer

12/6/03
Date

James E. Bruce
OU 1-10 Comprehensive Project Manager

10/6/03
Date

ABSTRACT

This field sampling plan describes the Waste Area Group 1, Operable Unit 1-10, Group 3 remedial action field sampling activities to be performed at the Idaho National Engineering and Environmental Laboratory for the Technical Support Facility (TSF)-03 Burn Pit site. The sampling activities described in this plan support the remedial actions presented in the ***Record of Decision for Test Area North, Operable Unit 1-10,*** and are in accordance with the ***Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory.***

Data quality objectives for this sampling plan address all sampling requirements identified for the remedial actions. The results of these sampling efforts will support post-excavation confirmation sampling to ensure that the final remediation goals for the site have been met.

This field sampling plan supports the site-specific remedial actions, including sampling, quality assurance, quality control, analytical procedures, and data management. Full implementation of the field sampling plan will ensure that the final remediation goals established in the Record of Decision are met at the site, and that data are scientifically valid, defensible, and of known and acceptable quality. The quality assurance project plan describes project objectives and quality assurance/quality control protocols that will achieve the specified data quality objectives.

CONTENTS

FIGURES

TABLES

ACRONYMS

AA	alternative action
AL	action level
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
D&D&D	deactivation, decontamination, and decommissioning
DAR	document action request
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
DOT	U.S. Department of Transportation
DQO	data quality objective
DS	decision statement
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ESD	explanation of significant differences
ESH&Q	environment, safety, health, and quality
FFA/CO	Federal Facility Agreement and Consent Order
FR	Federal Register
FRG	final remediation goal
FSP	field sampling plan
FTL	field team leader
HASP	health and safety plan

HAZWOPER	Hazardous Waste Operations
HSO	health and safety officer
HWMA	Hazardous Waste Management Act
ICDF	INEEL CERCLA Disposal Facility
ID	identification
IDEQ	Idaho Department of Environmental Quality
IEDMS	Integrated Environmental Data Management System
IET	Initial Engine Test
IH	industrial hygiene
INEEL	Idaho National Engineering and Environmental Laboratory
LOFT	Loss-of-Fluid Test
MCP	management control procedure
MDA	minimum detectable activities
MDL	method detection limits
MQO	measurement quality objectives
OSHA	Occupational Safety and Health Administration
ou	operable unit
PCB	polychlorinated biphenyl
PM	project manager
PPE	personal protective equipment
PRD	program requirements document
PSQ	principal study question
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RA	remedial action

RadCon	radiological control
RBC	risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RI/FS	remedial **investigatiodfeasibility** study
ROD	Record of Decision
SAM	Sample and Analysis Management
SAP	sampling and analysis plan
SC	sample custodian
SMC	Specific Manufacturing Capability
SOW	statement of work
SVOC	semi-volatile organic compound
TAN	Test Area North
TBD	to be determined
TSF	Technical Support Facility
UCL	upper confidence limit
UST	underground storage tank
VOC	volatile organic compound
WAC	Waste Acceptance Criteria
WAG	Waste Area Group
WGS	Waste Generator Services
WMP	waste management plan
WRRTF	Water Reactor Research Test Facility

Field Sampling Plan for Group 3, TSF-03 Burn Pits for Test Area North, Waste Area Group 1, Operable Unit 1-10

1. INTRODUCTION

This field sampling plan (FSP), when implemented with the current revision of the ***Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites*** (QAPjP) (U.S. Department of Energy Idaho Operations Office [DOE-ID] 2002a), comprises the sampling and analysis plan (SAP) for the Idaho National Engineering and Environmental Laboratory (INEEL) Waste Area Group (WAG) 1, Test Area North (TAN), Operable Unit (OU) 1-10, Group 3 activity.

This FSP will be used to conduct sampling to support the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) remedial actions (RAs) for the Technical Support Facility (TSF)-03 Bum Pit site.

This FSP, prepared in accordance with the ***Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*** (FFNCO) (DOE-ID 1991), outlines the sampling requirements and quality assurance (QA), quality control (QC), analytical, and data management procedures to be used to sample the TSF-03 soils, as specified in the final Record of Decision (ROD) for OU 1-10 (DOE-ID 1999a). The QAPjP describes QA/QC protocols that will achieve the specified data quality objectives (DQOs). Use of this FSP will help ensure that data are scientifically valid, defensible, and of known and acceptable quality, while use of the QAPjP will ensure that the data generated are suitable for their intended purposes.

This FSP is identified as a secondary document under the FFNCO and fulfills the specified FFNCO requirements. The QAPjP and this FSP have been prepared pursuant to the ***National Oil and Hazardous Substances Contingency Plan*** (U.S. Environmental Protection Agency [EPA] 1990), the ***Guidance for Conducting Remedial Investigations and Feasibility Studies under the Comprehensive Environmental Response, Compensation, and Liability Act*** (EPA 1988), the ***FFNCO***, and Environmental Restoration (ER) Management Control Procedure (MCP)-241, "Preparation of Characterization Plans."

1.1 Field Sampling Plan Objectives

The overall objective of this FSP is to guide the collection and analyses of sample data during implementation of selected RAs for TSF-03 presented in the OU 1-10 ROD. The ROD-selected remedy for TSF-03 includes excavating the Burn Pit materials, disposing of them appropriately, performing confirmation sampling, backfilling the excavation with clean fill, and contouring and reseeding the area.

Based on the DQOs developed for the project's sampling requirements, this FSP will support post-remediation sampling to verify that the CERCLA ROD-defined final remediation goals **(FRGs)** have been met and are adequate to ensure protection of human health and the environment.

1.2 INEEL CERCLA Disposal Facility Requirements

This FSP is designed to support remediation activities, ensuring that all wastes generated during implementation of the TSF-03 RA will meet associated waste characterization requirements for future waste disposal at INEEL CERCLA Disposal Facility (ICDF).

The ICDF Complex is designed to provide centralized receiving, inspection, and treatment and segregation areas necessary to stage and store incoming waste from various INEEL CERCLA remediation sites prior to disposal at the ICDF landfill or evaporation ponds, or shipment off-site. Only INEEL on-site CERCLA wastes meeting the appropriate ***ICDF Complex Waste Acceptance Criteria*** (WAC) (DOE-ID 2002b) will be accepted at ICDF.

A material profile of the waste to be disposed of at ICDF (in this case, the TSF-03 Bum Pit material and soil) will be developed by the remediation contractor, per the ***ICDF Complex Material Profile Guidance*** (DOE-ID 2003a), prior to waste disposal. Therefore, verification of the waste will be performed by ICDF, as specified in the ***ICDF Complex Waste Verification Sampling and Analysis Plan*** (DOE-ID 2003b), to confirm that key parameters in the waste do not exceed the limits on the material profile. Key parameters are those identified as impacting ICDF operations or limiting acceptance of waste in the landfill, as defined by the ICDF WAC and/or operational limits. Waste verification can include visual inspection of the waste, administrative controls, documentation and calculation reviews, or verification sample collection. Where possible, ICDF waste verification activities will be coordinated with the sampling effort described in this FSP.

Regulatory limits on radionuclide activity that can be disposed of in the ICDF landfill are invoked by the ROD (DOE-ID 1999b) and DOE Order 435.1, "Radioactive Waste Management," as discussed in the ***Waste Acceptance Criteria for the ICDF Landfill*** (DOE-ID 2002c).

2. SITE BACKGROUND

The INEEL, a government-owned facility managed by the Department of Energy (DOE), is located in southeastern Idaho, 51.5-km (32-miles) west of Idaho Falls, as shown in Figure 2-1. The INEEL encompasses approximately 2,305 km^2 (890 mi^2) of the northwestern portion of the eastern Snake River Plain, and extends into portions of five Idaho counties.

In November 1989, because of confirmed contaminant releases to the environment, the EPA placed the INEEL on the National Priorities List of Uncontrolled Hazardous Waste Sites (54 Federal Register [FR] 48184). In response to this listing, the DOE, EPA, and the Idaho Department of Environmental Quality (IDEQ), (herein referred to as the Agencies) negotiated the FFNCO and Action Plan. The Agencies signed these documents in 1991, establishing the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the INEEL in accordance with CERCLA, Resource Conservation and Recovery Act (RCRA), and the Idaho Hazardous Waste Management Act (HWMA).

To better manage cleanup activities, the INEEL was divided into 10 WAGs. Test Area North, in Figure 2-2, is designated as WAG 1, and includes fenced areas and immediate areas outside the fence lines at the TSF, the Initial Engine Test (IET) Facility, the Loss-of-Fluid Test (LOFT) Facility and Specific Manufacturing Capability (SMC) Facility, and the Water Reactor Research Test Facility (WRRTF) (DOE-ID 1999a).

The TAN facility was constructed between 1954 and 1961 to support the Aircraft Nuclear Propulsion Program, which developed and tested designs for nuclear-powered aircraft engines. When Congress terminated this research in 1961, the area's facilities were converted to support a variety of other DOE research projects. From 1962 through the 1970s, the area was principally devoted to the LOFT Facility, where reactor safety testing and behavior studies were conducted. Beginning in 1980, the area was used to conduct research and development with material from the 1979 Three Mile Island reactor accident (DOE-ID 1998). During the mid-1980s, the TAN Hot Shop supported the final tests for the LOFT Program. Current activities include the manufacture of armor for military vehicles at the SMC Facility. Deactivation, decontamination, and decommissioning (D&D&D) has recently been completed at the IET Facility.

The FFNCO established ten OUs within WAG 1 consisting of 94 potential release sites (DOE-ID 1999a). The sites include a variety of pits, spills, ponds, aboveground and underground storage tanks, and a railroad turntable. A comprehensive remedial investigatiodfeasibility study (RI/FS) was initiated in 1995 to determine the nature and extent of the contamination at TAN under OU 1-10, defined in the FFA/CO as the ***WAG I Comprehensive Remedial Investigation/Feasibility Study*** (DOE-ID 1997). The OU 1-10 RI/FS culminated with the finalization of the OU 1-10 ROD (DOE-ID 1999a), which provides information to support RAs for eight sites where contaminants present an unacceptable risk to human health and the environment.

Final remediation goals were established for each site to ensure a risk-based protectiveness of human health and the environment by providing unrestricted land use in 100 years. These goals, which are both contaminant- and site-specific, are quantitative cleanup levels based primarily on applicable or relevant and appropriate requirements (ARARs) and risk-based doses. The FRG, identified in Table 4 of the Explanation of Significant Difference (ESD) to the ROD (DOE-ID 2003c), is 400 mg/kg lead for TSF-03.

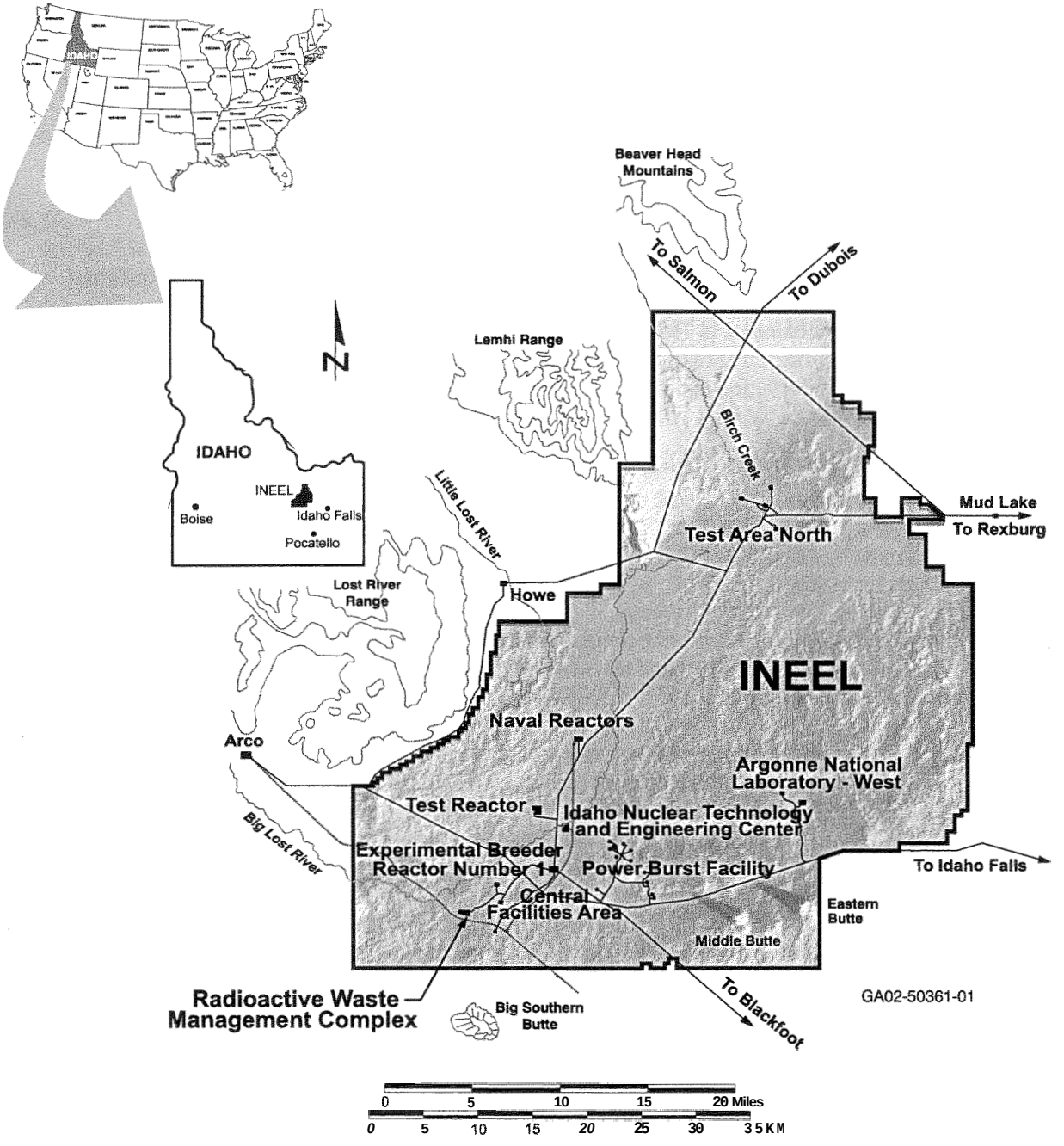


Figure 2-1. Location of the INEEL

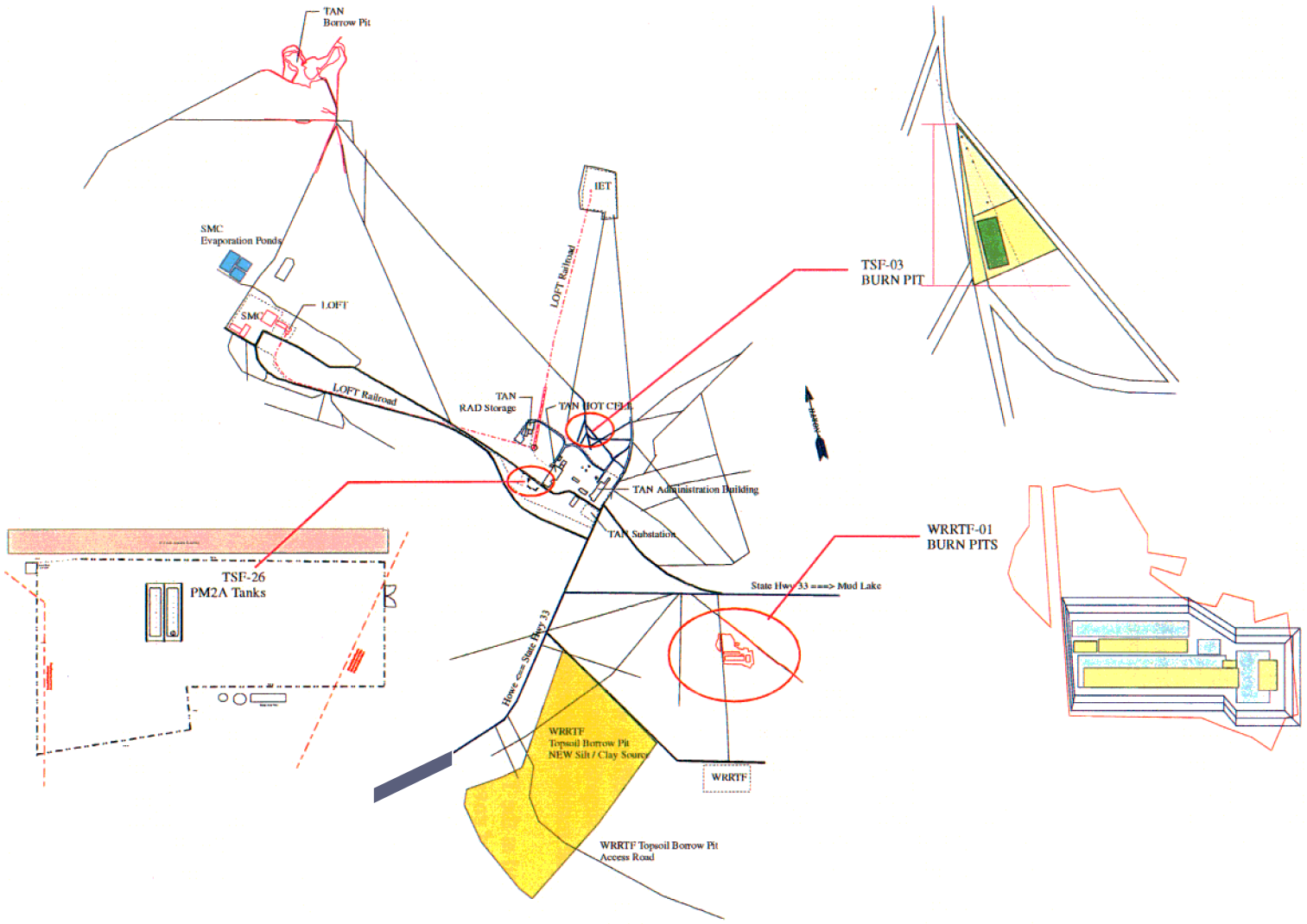


Figure 2-2. WAG 1 Test Area North Facilities.

2.1 Site TSF-03

The TSF-03 Burn Pit is located northwest of TSF, outside the TSF perimeter fence (see Figure 2-2). The Burn Pit was used for open burning of construction debris and wastes generated at the TAN Facility. From 1953 to 1958, the pit received refuse, construction debris, and combustible liquids (i.e., petroleum products) from the TAN Areas (INEL 1993). At that time, burning waste materials in the pits was standard operating procedure. The use of this pit was discontinued when similar disposal operations started at the WRRTF-01 Burn Pits in 1958. Normally, burns were conducted each time materials were disposed of in the pit. Records describing the types or volume of materials disposed of and burned in the pit were not kept.

Materials such as glass, metallic objects, fiberglass, and charcoal were identified through sampling (see Subsection 2.2). The types of materials disposed of in the pit were largely determined from process knowledge of TAN activities and historical information. It is expected that RCRA wastes were not disposed of at this site.

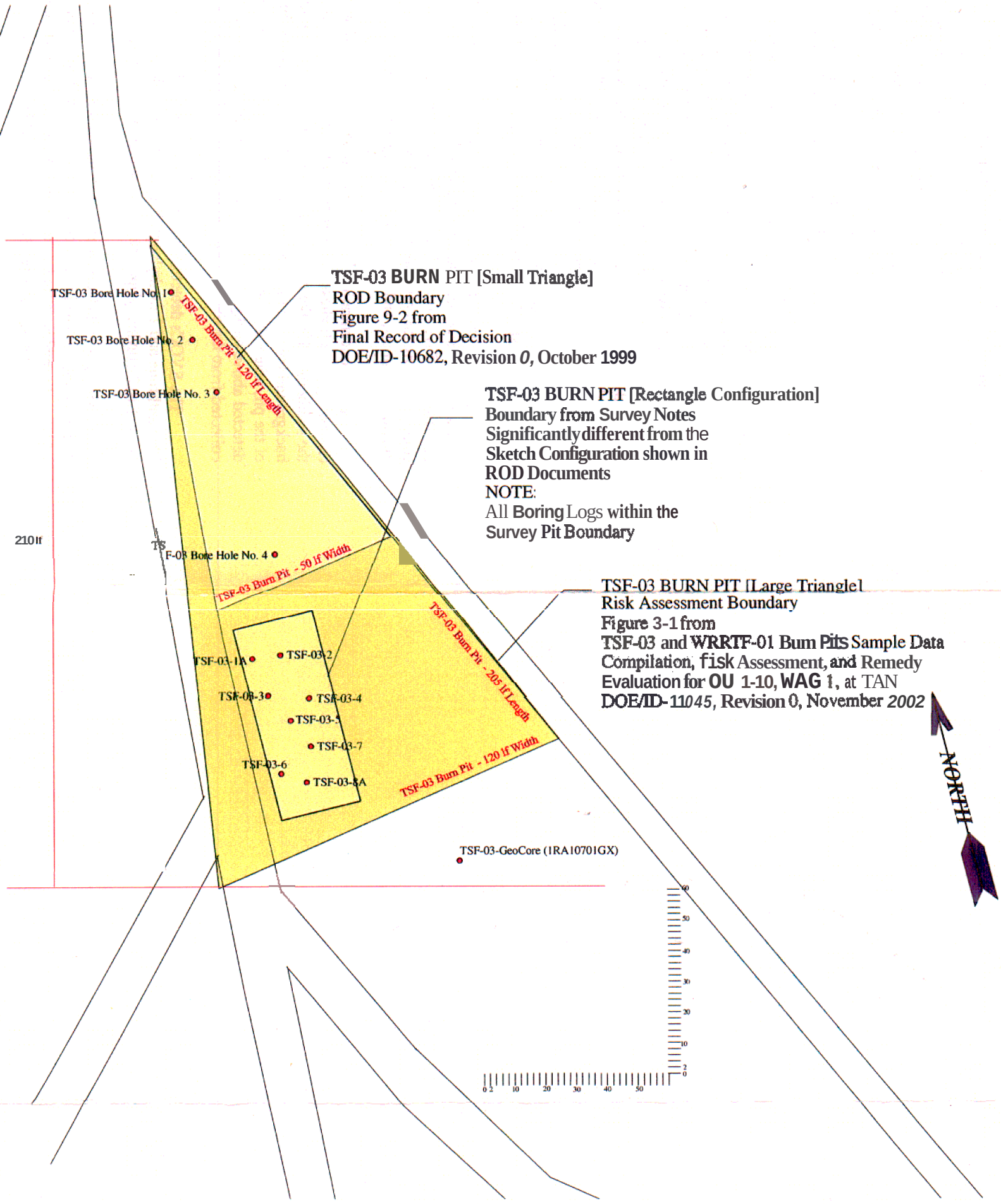
The TSF-03 Site has been backfilled with 2 to 6 ft of clean soil, and vegetation has been naturally reestablished, minimizing exposure of personnel to potentially hazardous conditions.. Subsidence control has been maintained at this site. Presently, the TSF-03 Burn Pit is administratively controlled with signs identifying it as a CERCLA site. No activities can be performed at the pit without contacting the INEEL ER Program. Figure 2-3 indicates the pit boundaries as documented in the ROD (DOE-ID 1999a), the data compilation/risk assessment report (DOE-ID 2003d), and the revised boundaries used in the TSF-03 design, which are based on survey data and a walkdown of the site in 2003.

2.2 Previous Investigations

Site characterization efforts were performed at the TSF-03 Burn Pit during two field investigation events: the Track 2 investigations in 1992 (DOE-ID 1997) and the 2001/2002 resampling effort (DOE-ID 2003d). The results of these sampling efforts are discussed below.

Data collected at the TSF-03 Burn Pit during the Track 2 investigation consisted of geophysical surveys and analyses of environmental samples collected from the burn layer and underburden. Samples were analyzed for select analyte metals (chromium, lead, and mercury), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and gross alpha, beta, and gamma radiation. The specific radionuclides analyzed included americium (Am)-241, plutonium (Pu)-241, Pu-238, Pu-239/240, uranium (U)-235, U-238, strontium (Sr)-90, cesium (Cs)-137, and cobalt (Co)-60. The geophysical surveys, soil boring data, and visual inspections detailed in the Track 2 investigation provided information concerning the dimensions of the pit, the depths of the clean soil cover, and the location and thickness of the burn layer. The borehole locations also indicated the upper and lower extents of the burn layers.

Figure 2-3. Historical and current TSF-03 pit boundaries.



Based on these data, the dimensions of the TSF-03 Burn Pit were estimated to be 8.0 m wide (26 ft) by 19.5 m long (64 ft). Data indicated the average soil cover (i.e., fill material placed on top of the bum layer) thickness was 1.4 m (4.5 ft), ranging from 0.6 to 1.8 m (2 to 6 ft). The average burn layer thickness was determined to be 1.8 m (6 ft), and pit depths ranged from 2.7 to 3.7 m (9 to 12 ft). Burn layer data from borehole drilling indicated the average upper and lower extents of the bum layer were 1.4 to 3.2 m (4.5 to 10.5 ft), respectively. The materials encountered during the borings included glass, metallic objects, fiberglass, and charcoal. The depths of the pit (base of the burn layer) ranged from 2.7 to 3.7 m (9 to 12 ft) below ground surface. Native soil characteristics included poorly graded sand containing silt or clay or both. Distance to the upper surface of the basalt was not determined at the Burn Pit.

Contaminants detected in samples collected from the burn layer in amounts exceeding the INEEL background concentrations included tetrachloroethene, VOCs, mercury, chromium, lead, U-234, and U-238. The presence of these contaminants is consistent with the disposal practices at the Bum Pit. The interval assumed to be contaminated with only mercury, chromium, and lead is from the shallowest bum layer occurrence at 2.7 m (9 ft) to the deepest sampling depth of 5.9 m (19.5 ft). These assumptions are considered conservative based on the sample analysis results (only lead was significantly above the INEEL background concentration of 23 mg/kg in the deepest sample) and using the minimum clean soil cover and maximum bum layer interval thickness. An additional conservative assumption used in defining the nature and extent of contamination is that, although a particular contaminant may not have been detected in all samples for a given interval, that interval is considered to be contaminated with that particular contaminant. Also, since no SVOC data was available for TSF-03, but the available data suggested the presence of SVOCs, the SVOC data from WRRTF-01 Bum Pit III was included in the assessment of TSF-03 to extrapolate SVOC concentrations at TSF-03.

A resampling effort was conducted at the TSF-03 Burn Pit in 2000/2001. The field sampling logs reviewed for this project did not contain a description of the materials encountered during this investigation. Five overburden samples, eight burn layer samples, and eight underburden samples were collected during this resampling effort. The samples were analyzed for metals, SVOCs, radionuclides, dioxins and furans, and polychlorinated biphenyls (PCBs).

Lead concentrations in the overburden samples were generally below background levels (23 mg/kg). The highest concentrations of lead in the bum layer were found at the center of the pit and at the southern end of the pit. The maximum concentration found was 705 mg/kg. Lead was below background levels in the samples collected in the underburden samples except at a location in the center of the pit, where the concentration of lead was just above background at 25.6 mgkg. Chromium was detected above background levels (50 mgkg) in four samples collected in the bum layer. Samples collected from the overburden and underburden layers were below background levels.

The SVOCs detected included 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, and phenanthrene. Phenanthrene and 2-methylnaphthalene were each detected in only one sample at one location in the bum layer. Bis(2-ethylhexyl)phthalate was detected in the overburden layer and the bum layer.

Americium-241 was detected above background levels (0.019 pCi/g) in samples collected from the TSF-03 bum pit. The highest concentrations were detected in the overburden and burn layers. Twelve additional samples, including three overburden and nine bum layer samples, exceeded background levels. All underburden samples registered below the background level.

Plutonium-238 was also detected above background levels at the TSF-03 Bum Pit. Eight samples, including three overburden samples and five burn layer samples, exceed the Pu-238 background level of 0.0091 pCi/g. All of the underburden samples were below the background level.

All samples where radium-228 was detected exceed the radium-228 background level of 0.38 pCi/g. The samples that exceed background include four overburden samples, eight burn layer samples, and eight underburden samples.

Chemicals detected in the soil samples included 14 dioxins and furans. The EPA Office of Solid Waste and Emergency Response has issued guidance establishing 1 ppb toxic equivalent as the recommended cleanup level for dioxins and furans for residential exposure scenarios. The mean exposure concentration (95% upper confidence limit) at TSF-03 is 0.5 ppb toxic equivalent or approximately half the recommended cleanup level. Only one of 13 mixed-zone soil samples exceeded the recommended cleanup level. However, dioxins and furans will be removed concurrently with the lead during excavation of the TSF-03 area.

The PCBs detected included Aroclor-1254, -1260, and -1262. The PCBs were detected in two overburden samples and six bum layer samples. The PCBs were not detected in the sample collected in the underburden layer at one location.

3. PROJECT ORGANIZATION AND RESPONSIBILITIES

A clearly defined project organization is essential to ensuring that project remediation objectives are achieved and that data collection, reporting, evaluation, and interpretation requirements are met. The following sections outline the specific responsibilities of key site personnel.

3.1 Key Personnel Responsibilities

Responsibilities for key personnel associated with the field activities described in this **FSP** are outlined in the following sections.

3.1.1 Project Manager

The WAG 1 project manager **(PM)** will ensure that all activities conducted during the project comply with INEEL **MCPs,** program requirements documents **(PRDs),** and all applicable Occupational Safety and Health Administration (OSHA), **EPA,** DOE, **U.S.** Department of Transportation (DOT), and State of Idaho requirements. The **PM** coordinates all document preparation; field, laboratory, and data evaluation; risk assessment, dose assessment, and closure design activities. The WAG 1 **PM** is responsible for the overall work scope, schedule, and budget.

3.1.2 Field Team Leader

The field team leader (FTL) will be delegated responsibility for the safe and successful completion of the sampling activities outlined in this **FSP.** The **FTL** works with the environment, safety, health, and quality (ESH&Q) oversight personnel and the field team to manage field-sampling-related operations and to execute this **FSP.** The **FTL** enforces site control, documents activities, and conducts the daily safety briefings at the start of each shift. Health and safety issues may be brought to the attention of the FTL by any team member.

The FTL serves as the representative for the ICP Program at the site. The FTL is responsible for field activities, crafts personnel, and other personnel assigned to work at the site. The FTL will serve **as** the interface between facility operations and project personnel and will work closely with the sampling team at the site to ensure the objectives of the project are accomplished in a safe and efficient manner. The FTL will work with all other identified project personnel to accomplish day-to-day operations at the site, identify and obtain additional resources needed at the site, and interact with the ESH&Q oversight personnel on matters regarding health and safety. The FTL will conduct all daily prejob briefings.

3.1.3 ESH&Q Oversight

The ESH&Q oversight personnel are the primary source for information regarding hazardous and toxic agents at the site. ESH&Q oversight personnel assess the potential for worker exposure to hazardous agents according to the INEEL Safety and Health **Manual, MCPs, PRDs,** and accepted industrial hygiene (IH) practices and protocol. The ESH&Q oversight personnel will ensure that all work is performed in accordance with INEEL **MCP-3562** and STD-101. By participating in site characterization, ESH&Q oversight personnel assess and recommend appropriate hazard controls for the protection of site personnel, and operate and maintain airborne sampling and monitoring equipment, as appropriate. The ESH&Q oversight personnel also recommend and assess the use of personal protective equipment (PPE) in the project health and safety plan (HASP) or other health and safety documentation such as safe work permits or radiological work permits.

In the event of an evacuation, the ESH&Q oversight personnel, in conjunction with other recovery team members, will assist the PM in determining whether conditions exist for safe site reentry. Personnel showing symptoms of health effects resulting from possible exposure to hazardous agents will be referred to an occupational medical program physician by their supervisor or by ESH&Q oversight personnel. The ESH&Q oversight personnel may have other duties at the site, as specified in other sections of the HASP, PRDs, and/or MCPs. During emergencies involving hazardous materials, airborne sampling and monitoring will be coordinated with members of the Emergency Response Organization.

3.1.4 Waste Generator Services

The INEEL Waste Generator Services (WGS) waste technical specialist will ensure that disposition of waste material is in compliance with identified guidance. WGS personnel have the responsibility to help solve waste management issues at the task site. Personnel also prepare the appropriate documentation for waste disposal and make the proper notifications, as required. All wastes will be managed and disposed of according to the project-specific waste management plan (WMP) (INEEL 2003a).

3.1.5 Radiological Control

Radiological control personnel will be involved with all aspects of the project where a potential for radiation exposure exists. Monitoring the work environment to ensure the safety of personnel at INEEL laboratories, all activities will comply with Bechtel BWXT Idaho, LLC MCPs. The radiological controls and personnel monitoring requirements established for this sampling effort in the project HASP are based on personnel dose history and radiological survey data collected during past work activities at the site. These data will be used to implement action levels (ALs) that will help ensure that all work activities and personnel exposure to radiation are maintained as low as reasonably achievable.

3.1.6 Sampling Team Members

The sampling team will consist of sampling personnel who are fully trained and skilled in standard sampling procedures for sampling soils. All sampling team personnel will be qualifified in accordance with the project-specific training matrix. The team will be responsible for collecting samples in sufficient numbers to comply with the requirements of this FSP. Radiological control personnel will perform direct surveys of the collected samples prior to placement in the transport container. At the end of each sampling effort, the sampling team, under direct supervision of ESH&Q oversight personnel, will be responsible for removal and transport of any sampling equipment brought into the sampling area to a decontamination area. Waste management will be performed in accordance with the provisions outlined in the project specific WMP (INEEL 2003a).

Sampling team members will be experienced in all aspects of soil sampling. They must be trained to procedures for collection of representative sample and trained to the many TAN and INEEL environmental safety and health procedures and policies. Each member of the sampling team will have up-to-date training relating to site hazards, including OSHA hazardous waste site worker training, radiation worker training, and other training deemed applicable by the PM, FTL, and the health and safety organization.

3.1.7 Sampling and Analysis Management Group

The Sampling and Analysis Management (SAM) group will serve as the principal point-of-contact for coordinating off-site laboratory activities. The responsibility of coordination may be delegated to a representative within the SAM organization. The SAM representative will have ultimate responsibility for

the technical quality of all laboratory deliverables, cost control, laboratory personnel management, and for ensuring that the samples are analyzed and data are reported on schedule.

3.1.8 Laboratory Quality Assurance Officer

The laboratory QA officer will evaluate all laboratory-generated data prior to release and:

- Determine if instrument calibrations were performed in accordance with the analytical statement of work (SOW) provided to the laboratory, which prescribes analytical methods
- Determine if all method QC analyses comply with the requirements of the SOW and analytical methods
- Determine if the data reporting format complies with the requirements stipulated by the project in the SOW.

The laboratory QA officer will notify the SAM point-of-contact of all noncompliance as soon as possible and will seek immediate corrective action through the SAM point-of-contact.

3.1.9 Laboratory Sample Custodian

The laboratory sample custodian (SC) will be responsible for maintaining sample custody, assigning laboratory identification numbers, and storing samples. The SC will review all chain of custody forms, accompanying field radiological surveys, and all sample container identifications to ensure compliance with project procedures. In the event of field radiological survey errors, the SC will notify the SAM point-of-contact and seek to rectify the error immediately. All discrepancies will be documented in a laboratory logbook and copies transmitted to the laboratory QA officer and the SAM point-of-contact to ensure that appropriate corrective actions have been developed. Discrepancies in sampling documentation are documented on the INEEL chain of custody form or on a laboratory-specific sample receiving checklist, which becomes part of the data package.

3.2 Non-Field Team MembersNisitors

All persons on the work site who are not part of the field team (e.g., surveyor, equipment operator, or other craft personnel not assigned to the project) are considered non-field team members, or visitors, for the purposes of this project. A person will be considered "on-site" when they are present in or beyond the designated support zone. Per 29 Code of *Federal* Regulations (CFR) 1910.120/1926.65, non-field team members are considered occasional site workers and must

- Receive any additional site-specific training identified in the project HASP prior to entering beyond the support zone of the project site
- Meet all required training for the tasks being performed, as identified in the project HASP
- Meet minimum training requirements for such workers as described in the OSHA standard
- Meet the same training requirements as the workers if the non-worker's tasks require entry into the work control zone.

Training must be documented and a copy of the documentation must be incorporated into the project field file. A site supervisor (e.g., health and safety officer [HSO] or FTL) will supervise all

non-field team personnel who have not completed their three days of supervised field experience, in accordance with the Hazardous Waste Operations (HAZWOPER) standard. Non-field team members/visitors may not be allowed beyond the support zone during certain project site tasks (e.g., drilling) to minimize exposure to safety and health hazards. The determination of any visitor's "need" for access beyond the support zone at the project site will be made by the HSO in consultation with TAN Radiation Control (RadCon) personnel (as appropriate).

3.3 Points of Contact

Table 3-1 lists the key points of contact for the TAN, WAG 1, OU 1-10 field activities for TSF-03. The points of contact listed in the table are those personnel anticipated as potential contacts necessary in sampling operations. This table is subject to change due to reassignment of personnel. A current copy of this table will be posted at the job site for reference during all project activities. Revisions to this table will not require a document action request because the current job positions will be posted at the job site.

Table 3-1. TSF-03 points of contact.

Name	Title	Telephone Number
Al Jantz	WAG 1 Project Manager	526-8517
Dave Eaton	WAG 1 Regulatory Support	526-7002
Gary McDannel	WAG 1 Project Engineer	526-5076
Jim Bruce	OU 1-10 Remedial Design/Remedial Action Project Manager	526-4370
Mark Langlois	Health and Safety Officer	526-2160
Mark Elliot	Field Team Leader	526-0872
Todd Lewis	Industrial Hygienist	526-6856
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4. QUALITY OBJECTIVES AND MEASUREMENT CRITERIA

The following sections outline the objectives of the sampling activities described in this FSP and the criteria associated with data collected. The DQOs and measurement performance criteria are developed and discussed in detail.

4.1 Data Quality Objectives

The DQO process, which is used to qualitatively and quantitatively specify the objectives for the data collected, was designed as a specific planning tool to establish criteria for defensible decision making and to facilitate the design of data acquisition efforts. The DQO process is described in Datu ***Quality Objectives for Hazardous Waste Site*** *Investigations* (EPA 2000a). The DQO process includes seven steps, each of which has specific outputs. Each of the following subsections corresponds to a section in the DQO process, and provides the output for each step.

4.1.1 Problem Statement

The first step in the DQO process is to use relevant information to clearly and concisely state the problem to be resolved. Its intent is to define the problem so that the focus of the sampling and analysis will be unambiguous.

The problem statement is as follows: sampling is required to verify that residual contaminant concentrations do not exceed **CERCLA** FRGs following completion of the remediation activities. Additionally, sampling is required to verify that the total cumulative risk for residual contaminant concentrations does not exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use for the TSF-03 Site following completion of the RA.

4.1.2 Principal Study Questions and Decision Statements

This step in the DQO process identifies the decisions and actions that will be taken based on the data collected. The study questions and their corresponding alternative actions (AA) will then be joined to form decision statements (DSs). The objective of this characterization activity is to answer the principal study questions (PSQs).

The objective of soil sampling is specified in this FSP to verify compliance with **CERCLA** FRGs following initial burn pit excavation, and to answer the following PSQ:

- PSQ1 : Do residual concentrations of contaminants in the soils within the excavated area for which **CERCLA** FRGs have been established meet the associated **CERCLA** FRGs?

  The AAs to be taken, depending on the resolution to PSQ1, are as follows:

  - AA1.1: If the residual concentrations of contaminants for which **CERCLA** FRGs have been established meet the associated **CERCLA** FRGs, then no further action is required for the soils.

  - AA1.2: If the residual concentrations of contaminants for which **CERCLA** FRGs have been established do <u>not</u> meet the associated **CERCLA** FRGs, then subsequent excavation will be performed until the **CERCLA** FRGs are met.

Combining PSQl and the associated AAs results in the following DS:

- DS1: Determine whether or not the residual concentrations of contaminants in the soils within the excavated area for which CERCLA FRGs have been established meet the associated CERCLA FRGs, and whether subsequent excavation is required.

The objective of the soil sampling specified in this FSP to evaluate cumulative risk for residual contaminant concentrations is to answer the following PSQ:

- PSQ2: Do residual concentrations of contaminants in the soils within the excavated area exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use?

The AAs to be taken, depending on the resolution to PSQ2, are as follows:

- AA2.1: If residual concentrations of contaminants in the soils within the excavated area do not exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use, then no further remediation activities are required.

- AA2.2: If residual concentrations of contaminants in the soils within the excavation area exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use, then subsequent excavation will be performed until the total cumulative risk is less than 10^{-4}.

Combining PSQ2 and the associated AAs results in the following DS:

- DS2: Determine whether or not the residual concentrations of contaminants in the soils within the excavated area exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use and whether subsequent excavation is required.

4.1.3 Decision Inputs

The purpose of this step is to identify informational inputs that will be required to resolve the DSs and to determine which inputs require measurements.

The information required to resolve both DS1 and DS2 is the identification and quantification of all contaminants of concern (COCs) present in the soils remaining within the excavation area. The list of COCs (Table 4-1) is developed from historical process knowledge of the Bum Pit operations and existing analytical data from previous sampling events.

The ALs to resolve DS 1 are the TSF-03 FRGs defined in the OU 1-10 ROD.

Currently, there are no established ALs to resolve DS2. Resolution of DS2 will require an evaluation of the analytical data specified in this FSP for the COCs in the soil by WAG 1 project management to determine the cumulative risk associated with the COCs, and if necessary, additional RAs to be taken under the provisions of the FFA/CO.

4.1.4 Study Boundaries

The primary objectives of this step are to identify the population of interest, define the spatial and temporal boundaries that apply to each DS, define the scale of decision-making, and identify practical constraints that must be considered in the sampling design. Implementing this step helps ensure that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

Table 4-1. Analytical performance requirements for TSF-03.

Analyte List	Analytical Method	Analytical Data Category	Data Uses	Preliminary Action Level	Method Detection Limits	Accuracy Requirements
Lead	SW-846 Methods	Screening data	Extent of excavation	FRGs	0.6 mg/kg	70-130%
Dioxins/Furans	SW-846 Method 8280	Screening data	Extent of excavation	Risk-based levels	—[a]	—[b]
PCBs	SW-846 Method 8082	Screening data	Extent of excavation	Risk-based levels	350 µg/kg	—[b]
Chromium	SW-846 Methods	Screening data	Extent of excavation	Risk-based levels	10.0 mg/kg	70-130%

a. Detection limits for each dioxin/furan contaminant are specific to the individual analyte and are specified in the method associated with each analyte.
b. Accuracy requirements for organics are indicated in the method associated with each analyte.

The spatial boundaries of concern for this sampling effort are confined to the soil areas within the TSF-03 Bum Pit excavation boundaries. Theonly temporal constraint identified for this effort is that samples should be collected as soon after the excavation activities are completed as possible so as not to leave the excavation open any longer than necessary. Results obtained from this sampling effort will be considered as adequate to verify compliance with the OU 1-10 ROD requirements. No practical constraints are expected that would interfere with the collection of adequate soil volumes for analyses. Again, any limitations on data quality and/or usability resulting from sample collection constraints will be discussed in the data quality assessment report.

4.1.5 Decision Rules

The objective of this step is to define parameters of interest that characterize the population, specify the AL, and integrate previous DQO outputs into a single statement that defines the conditions that would cause the decision maker to choose among AAs. The decision rule typically takes the form of an "*If...then*" statement describing the action to take if one or more conditions are met.

The decision rule is specified in relation to a statistical parameter that characterizes the population of interest. The parameter of interest for the TSF-03 soil samples will be the true mean concentration, as estimated by the 95% upper confidence limit (UCL) of the sample mean, of the COCs. Therefore, the sample statistic of interest for the soils will be the 95% UCL of the sample mean concentrations for each COC.

The decision rule is based on the FFNCO requirement that residual contaminant concentrations meet the ROD-specified CERCLA FRGs with respect to the COCs for the site.

The decision rules originating from the FFACO are:

- *If* the true mean concentration of any COC for which a CERCLA FRG has been established, as estimated by the 95% UCL of the sample mean, that is detected in total constituent analyses of soil samples collected from the excavated area following soil excavation meets the associated CERCLA FRG, *then* no subsequent remediation activities will be required under the provisions of the FFA/CO.

- ***If*** the true mean concentration of any COC for which a CERCLA **FRG** has been established, as estimated by the 95% UCL of the sample mean, that is detected in total constituent analyses of soil samples collected from the excavated area following soil excavation does **not** meet the associated CERCLA FRG, ***then*** the extent of subsequent remediation activities will be evaluated under the provisions of the FFNCO.

  And:

- ***If*** the residual true mean concentrations of COCs detected in total constituent analyses of soil samples collected from the excavated area following soil excavation, as estimated by the 95% UCL of the sample mean, do **not** exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use, ***then*** no subsequent remediation activities will be required under the provisions of the FFNCO.

- ***If*** the residual true mean concentrations of COCs detected in total constituent analyses of soil samples collected from the excavated area following soil excavation, **as** estimated by the 95% UCL of the sample mean, exceed the acceptable cumulative risk range of 10^{-4} for unrestricted use, ***then*** the extent of subsequent remediation activities will be evaluated under the provisions of the FFNCO.

4.1.6 Decision Error Limits

Since analytical data can only provide an estimate of the true condition of the site under investigation, decisions based on measurement data could potentially be in error. For this reason, the primary objective of this step is to determine which DSs, if any, require a statistically based sample design. Determining the decision error limits specifies the decision-maker's tolerable limits on decision errors, which are used to establish performance goals for the data collection design.

Because decisions are based on measurement data, which provide only **an** estimate of the true state of the media being characterized, decisions are based on data that could be in error. Therefore, tolerable limits on the probability of making a decision error must be defined. The probability of decision errors can be controlled by using the data to select between one condition of the environment (i.e., the soil following excavation of the TSF-03 area) and the alternative condition. One condition is assumed to be the baseline condition and is referred to as the *null hypothesis* (Ho). The alternative condition is the *alternative hypothesis* (H»). The null hypothesis is presumed to be true in the absence of strong evidence to the contrary, which allows decision-makers to guard against making the decision error with the most undesirable consequences.

A decision error occurs when the decision-maker rejects the null hypothesis when it is true, or fails to reject the null hypothesis when it is false. These two types of decision errors are classified as *false positive and false negative* decision errors, respectively. False positive and false negative errors are defined in accordance with the definition of the null and alternative hypothesis. For example, a decision-maker presumes a certain waste is hazardous (i.e., the null hypothesis is "the waste is hazardous"). If the data cause the decision-maker to conclude that the waste is not hazardous when it truly is hazardous, then the decision-maker would make a false positive decision error. Statisticians refer to this error **as** a Type I error. The measure of the size of this error is called alpha ***(a)***, the level of significance, or the size of the critical region. If, however, the data cause the decision-maker to conclude that the waste is hazardous when, in fact, it is not, then the decision-maker would make a false negative decision error. Statisticians refer to this error as a Type 11 error. The measure of the size of this error is called beta (β), and is also known as the compliment of the power of a hypothesis test.

The possibility of decision error cannot be eliminated but it can be minimized, which is accomplished by controlling the total study error. Methods for controlling total study error include collecting a large number of samples (to control sampling design error), analyzing individual samples several times, or using more precise analytical methods (to control measurement error). The chosen method for reducing decision errors depends on where the greatest component of total study error exists in the data set and the ease in reducing the error contributed by those data components. The amount of effort expended on controlling decision error is directly proportional to the consequences of making an error.

The decision error that has the more severe consequences as the true concentrations of the parameters of interest approach the AL must be specified, as it is the basis for establishing the null hypothesis. This decision error is used because as the parameters approach the AL, the data are much more likely to lead to an incorrect decision than when the parameters are far above or below the AL. For regulatory compliance, human health, or environmental risk issues, the decision error that has the most adverse consequences will be favored as the null hypothesis. In statistical hypothesis testing, the data must conclusively demonstrate that the null hypothesis is false. Therefore, setting the null hypothesis to the condition that exists when the more adverse decision error occurs guards against making that decision error by placing the burden of proof on demonstrating that the most adverse consequences will not be likely to occur.

For **DS1**, the concentrations of COCs will be assumed to exceed the CERCLA FRGs unless proven otherwise (i.e., by collecting and analyzing samples following soil excavation). For **DS2**, the residual contaminant concentrations will be assumed to exceed a cumulative risk of 10^{-4} unless proven otherwise (i.e., by collecting and analyzing samples following soil excavation).

A range of possible parameter values must be specified where the consequences of decision errors are relatively minor. This range of values is referred to as the "gray region," which is bounded on one side by the AL and on the other side by the parameter value where making a false negative decision error begins to be significant (U). It is necessary to specify the gray region because the variability in the sample population and unavoidable imprecision in the measurement system combine to produce variability in the data such that a decision may be "too close to call" when the true parameter value is very close to the AL. In statistics, this interval is called the "minimum detectable difference" and is expressed as delta (A). The width of this gray region is critical in calculating the number of samples needed to satisfy the **DQOs.** A narrow gray region indicates a desire to detect conclusively the condition when the true parameter value is close to the AL. For the TSF-03 total constituent analysis, the gray region will be bounded on one side by the constituent-specific AL and on the other side by a value that is 80% of the constituent-specific AL.

The final activity required in specifying the tolerable limits on decision error is to assign values to the gray region that reflect the probability of decision errors occumng. These probability values are the decision-maker's tolerable limits for making an incorrect decision. These values are determined by selecting a possible true value for the parameter of interest, then choosing a probability limit based on an evaluation of the seriousness of the potential consequences of making a decision error if the true parameter value is located at that point.

The project team must determine the three variables (width of gray region, acceptable false positive decision error value when the true mean concentration is equal to the AL, and acceptable false negative decision error value when the true mean concentration is equal to U) and adjust them to acceptable tolerances. Then, the number of samples required to satisfy the **DQOs** can be determined. The sample collection design for the TSF-03 sampling activities is discussed in the following section. An acceptable false positive decision error value of 0.05 (when the true mean concentration is equal to the AL) and an

acceptable false negative decision error value of 0.20 (when the true mean concentration is equal to U) have been selected for this sampling design.

4.1.7 Design Optimization

The objective of this step is to identify the best sampling and analysis design that satisfies the previous DQO Steps 1 through 6. The activities required to optimize the design include:

- Review the outputs of the first six steps and existing environmental data
- Develop general data collection design alternatives
- Formulate a mathematical expression to solve the design problem for each data collection design alternative
- Select the optimal number of samples to satisfy the DQOs for each data collection design alternative
- Select the most resource-effective data collection design that satisfies all the DQOs.

The outputs of the first six steps have been discussed previously. There are existing environmental data relevant to the TSF-03 soils.

The remedial design currently specifies the use of visual observations to guide excavation of the burn pit layer. Based on visual observations, the overburden, bum layer, and underburden will be excavated.. Following excavation, a systematic random sampling approach, presented in Figure 4-1, will be used to determine sampling locations at TSF-03. With this approach, a grid is used to divide the sampling area into potential sampling locations, and a starting point is randomly selected. A random number generator is used to determine the remainder of the grid locations. During excavation, reasonable efforts will be made to identify the location of the original access ramp. If the original access ramp to the pit is identified, biased sampling of the ramp will be performed. These biased samples will be in addition to the sample locations identified in Figure 4-1.

When using a simple or composite random sampling approach, there are commonly accepted mathematical expressions (e.g., the Student's t distribution) to solve design problems for these data collection design alternatives (EPA **1989).** The formula for determining the number of samples to be collected is selected based on the hypothesis test and data collection design. In this case, the hypothesis test will be a one sample Student's *t* distribution of the mean versus AL. Using this hypothesis test, the formula shown below is used for computing the number of samples required for a simple random sampling approach:

$$n = \frac{\sigma^2 \left(Z_{1-\beta} + Z_{1-\alpha}\right)^2}{\Delta^2} + (.5)Z_{1-\alpha}{}^2 \qquad (4\text{-}1)$$

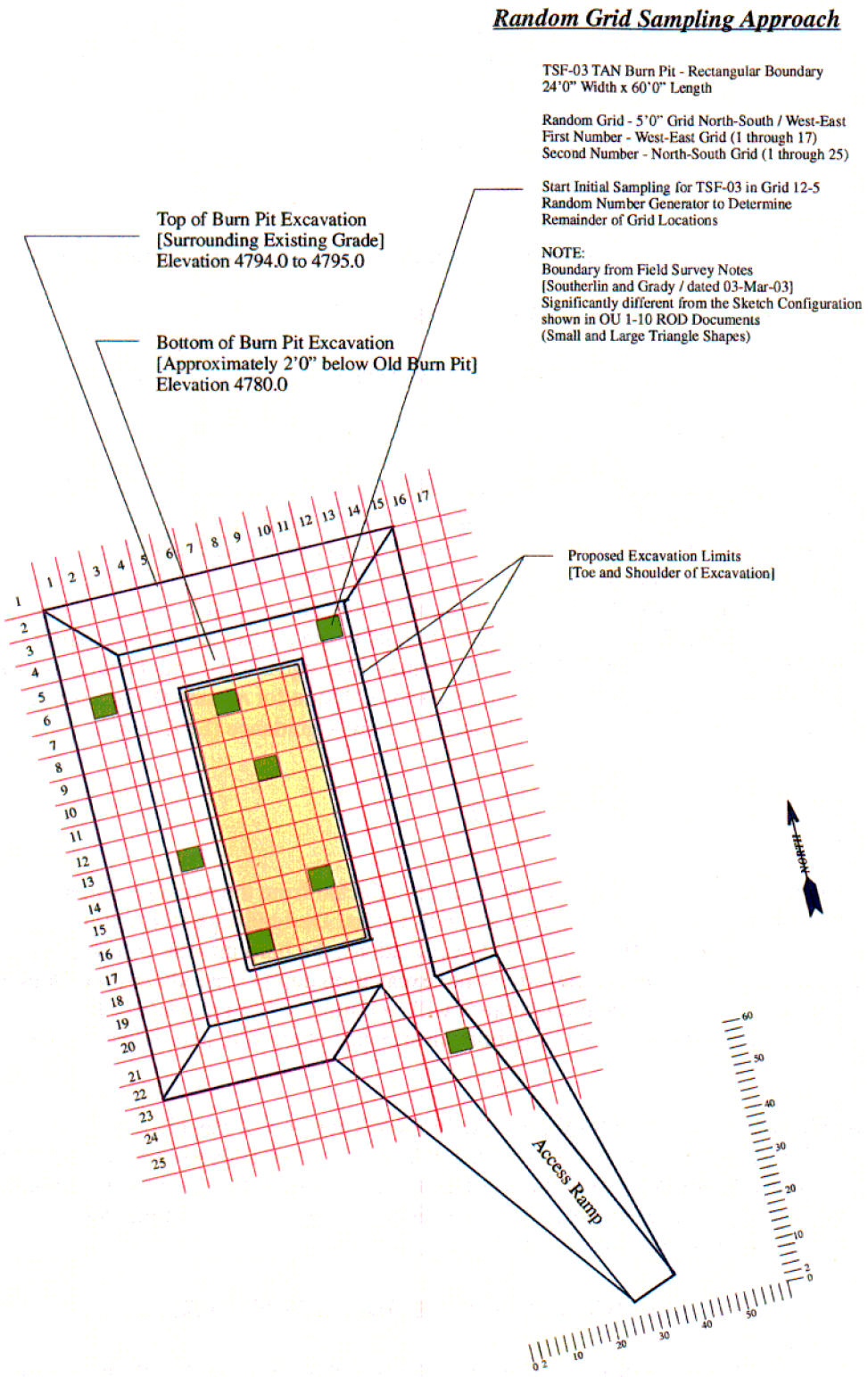

Figure 4-1. TSF-03 random grid sampling approach.

where

n = number of samples required

σ^2 = estimated variance in measurements

Z = the p^{th} percentile of the standard normal distribution (from statistical tables)

A = AL – U (the minimum detectable difference)

U = parameter value where making a false negative decision error begins to be significant

AL = action level.

Although it is generally assumed that the variability of the sampled soil matrix will be relatively high since homogeneity of the soil cannot be assumed, it is appropriate to apply a mid-range coefficient of variance (σ) to determine the number of samples required. Applying a systematic random sampling design at specified intervals within an established grid will develop the soil sample locations for TSF-03. Using a concentration that is 20% of the AL as σ, and assuming an acceptable chance of false positive decision error to be 5% when the true concentration is equal to the AL, an acceptable chance of false negative decision error to be 20% when the true concentration is equal to U, and the width of the gray region is 20% of the AL, the following equation shows the solution for n using the project-specific variables. The values for $1-\alpha$ and $1-\beta$ where obtained from EPA guidance (EPA 1988).

$$n = \frac{20^2(.842+1.645)^2}{20^2} + (.5)(1.645)^2 = 7.5 = 8 \qquad (4\text{-}2)$$

Thus, a minimum of eight samples (grab) will be collected from the excavated area, which includes the bottom surface and sidewalls. As indicated in the Remedial Design/Remedial Action Work Plan for Group 3, Appendix D (DOE-ID 2003e) TSF-03 Specifications, the bum pit area will be excavated to the underburden layer (previous sampling elevations and excavation depths are indicated on Drawings G-3 and C-1, respectively). Therefore, the grab samples will be collected from this layer. Because the soil samples will be collected as grab samples, minimal disturbance of the soil, and therefore, minimal sloughing, is expected.

The samples will be analyzed for the analyte listed in Table 4-1 of this plan. In addition to this sampling, X-ray fluorescence field analysis for lead will be performed following excavation, but prior to confirmation sampling, to aid in determining whether additional excavation is required to remove lead-contaminated soil. The X-ray fluorescence analysis is a nonintrusive, real-time field screening technique that is helpful in monitoring site cleanup progress.

4.2 Measurement Performance Criteria

The measurement quality objectives (MQOs) specify that measurements will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2002a). As a result, the technical and statistical quality of these measurements must be properly documented. Precision, accuracy, method detection limits (MDLs), and completeness must be specified for physical/chemical measurements. Additional analytical requirements are described qualitatively in terms of

representativeness and comparability. These **MQOs** are described in the following sections. Table 4-1 provides the overall performance criteria established for the TSF-03 sampling.

4.2.1 Precision

Precision is a measure of agreement or reproducibility among individual measurements for the same property under the same conditions. Precision is expressed **as** relative percent difference, which is defined, and shown in Equation (4-3), as the absolute value of the difference divided by the mean, expressed as a percentage.

$$RPD = \frac{(MS - MSD)}{(MS + MSD)/2} \times 100 \qquad (4\text{-}3)$$

where

RPD = relative percent difference

MS = measured concentration of parameter in matrix spike sample

MSD = measured concentration of parameter in matrix spike duplicate sample.

The analytical laboratory will report the precision of their measurements of the matrix spike and matrix spike duplicate analyses conducted for organic and most inorganic analyses. For all radiochemical and some inorganic measurements, precision will be calculated using duplicate measurements of the same sample. Replicate measurements are used for metals determination after sample preparation, during instrumental analysis, and for mercury determinations post-digestion. Radiochemical measurements will use separate sample splits for solid samples to determine measurement precision.

Acceptable laboratory precision will be determined by method-specific criteria outlined in SW-846, ***Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*** (EPA 1996), for total metals and each requested organic analysis. Acceptable radiochemical measurement precision will be determined using the guidance outlined in ***INEEL Sample and Analysis Management Statement of Work for Analytical Services,*** ER-SOW-394 (INEEL ***2002).***

4.2.2 Accuracy

Accuracy is the relative agreement or non-agreement between a measured value and an accepted reference value. Accuracy reflects the measurement error associated with a measurement and is determined by assessing actual measurements in the sample matrix during the analysis of matrix spike samples. Accuracy is assessed by means of determining analyte recovery from matrix spikes, samples, or laboratory reference samples and is expressed as a percent recovery (%R), defined as the measured value divided by the true value expressed **as** a percent, **as** shown in Equation (4-4):

$$\%R \frac{C_{ss} - C_{us}}{C_{as}} \times 100 \qquad (4\text{-}4)$$

where

%R = percent recovery

C_{ss} = measured analyte concentration in spiked sample

C_{us} = measured analyte concentration in non-spiked samples (or zero for laboratory reference samples)

C_{as} = calculated or certified analyte concentration added to sample.

For organic and inorganic analyses, the analytical laboratory will represent the accuracy of their measurements in the sample matrix as the results of the matrix spike data. For organic analyses, an additional measure of accuracy is provided by surrogate spike data. Surrogate spike compounds are analytes of similar chemical characteristic to the analytes of interest. They are added to all samples, matrix spikes, and blanks to test for possible bias added during the entire sample preparation and measurement process. Acceptable laboratory accuracy will be determined by assessing the results against method-specific criteria outlined in SW-846 (EPA 1996) for total metals, and each requested organic analysis. Radiochemical method accuracy will be determined by assessing the results against the criteria outlined in ER-SOW-394 (INEEL 2002). During the DQA process, accuracy of environmental measurements (in the form of bias may be indicated by the measure discussed above) will be assessed to determine if there are any impacts on data use due to the accuracy of the data.

4.2.3 Detection Limits

The laboratory will use guidance found in SW-846 (EPA 1996) or 40 CFR 136 Appendix B to aid in appropriately determining MDLs for organic and inorganic analytical methods and the requirements of ER-SOW-394 (INEEL 2002) for setting minimum detectable activities (MDAs) for radiochemical measurements to ensure that the MDLs and MDAs are below the **FRGs** established for this site. The MDLs and MDAs are defined as the minimum concentration or activity of a substance that can be reliably measured and reported by a particular analytical method. Matrix effects, sample size, radiation levels, or other analytical interferences may increase MDLs or MDAs. The effects of these conditions on the laboratory's MDLs or MDAs, if determinable, will be documented.

Chemical methods for all total metals, anions, and organic analyses typically use the standard deviation of replicate measurements of standards multiplied by a factor specified by the method or laboratory SOW to determine minimum MDLs. Estimated detection limits are provided in each of the appropriate analytical methods for chemical determinations and serve as a guide for purposes of this FSP. The laboratory will use standard radiochemistry and chemical analysis practices to ensure the MDLs approach those prescribed in the analytical laboratory SOW. Any significant deviations will be identified in the reported data.

Methods for the determination of radionuclides and applicable MDAs will be as defined in ER-SOW-394 (INEEL 2002) or as defined in the project-specific analytical laboratory SOW. The laboratory will attempt to keep MDAs as low as possible given the constraints of the sample matrix and any remote sample-handling operations required to ensure the safety of laboratory personnel.

The laboratory analysts will follow the SW-846 (EPA 1996) and ER-SOW-394 (INEEL 2002) methods as closely as possible to ensure that the data are compliant with the requirements of the project. A smaller sample size may introduce a dilution effect, thereby elevating the detection level for a given sample or analysis. In the event that sample volume (or mass) prohibits the use of SW-846 (EPA 1996) protocols, a different method may be necessary. Deviations from the protocols presented in SW-846 (EPA 1996) are allowed by the method and contained within the laboratory's standard operating procedures. The laboratory will document all method deviations in the case narrative provided with the data package.

4.2.4 Completeness

Completeness is the measure of the amount of valid analytical data obtained compared to the total number of data points planned. Valid analytical data are those generated when analytical systems and the resulting analytical data meet all DQOs outlined for the project (i.e., all calibration verification), and other checks not affected by the sample matrix meet acceptance criteria. It is important to understand that data flagged during the data validation process are not necessarily invalid data. Part of the DQA process is the review of flagged data to determine whether the validation flags impact the intended use of the data. Therefore, the definition of "valid data" in the context of calculating completeness is "data that are acceptable for their intended purpose." Completeness of the reported data (expressed as a percentage) is calculated, as shown in Equation (4-5).

$$C(\%) = M_v / Mt \times 100 \qquad (4\text{-}5)$$

where

C(%) = completeness

M_v = number of measurements determined to be valid per analyte

Mt = total number of measurements performed per analyte.

A completeness of 90% is a common goal. All data obtained from this project should meet the quality requirements and reporting protocols unless irregularities in the matrix (a.k.a. matrix effects) impede contaminant recovery or an accident results in a loss of sample materials. The completeness goal for the project is to obtain enough valid data to satisfy the DQO specifications.

4.2.5 Comparability

Comparability is the degree to which one data set can be compared to another obtained from the same population using similar techniques for data gathering. Comparability will be achieved through the use of consistent sampling procedures, experienced sampling personnel, the same analytical method for like parameters, standard field and laboratory documentation, and traceable laboratory standards.

4.2.6 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether in situ and other measurements are made and physical samples are collected in such a manner that the resulting data appropriately reflect population parameter of interest in the media and phenomenon measured or studied.

The sampling design discussed in Section 4.1.7 of this plan is the basis for obtaining data that are representative of the TSF-03 soil. A final determination of representativeness for the initial data set will be made by the PM and other project personnel following the return of the chemical and radiological analytical data.

4.3 Data Quality

In addition to primary project samples, QA/QC samples will be collected to establish the quantitative and qualitative criteria necessary to support the RA decision process and to describe the acceptability of the data by providing information both comparable to, and representative of, actual field conditions. Quality assurance/quality control samples consisting of field blanks and equipment rinsate blanks will be used to determine field accuracy. Quality control (duplicate) samples are used to measure field and laboratory precision. The QA/QC sample results will be evaluated as outlined in the QAPjP (DOE-ID2002a). Table 4-2 provides an overview of QA/QC sample analysis for this sampling effort.

Table 4-2. Quality assurance/quality control samples.

QA/QC Sample Type	Comment
Duplicate	Field duplicates will be collected at a frequency of 1/20 environmental samples or 1/day/matrix, whichever is less.
Field blanks	Field blanks will be collected at a frequency of 1/20 environmental samples or 1/day, whichever is less.
Trip blanks	Trip blanks will be collected 1/VOC cooler.
Equipment rinsate	Equipment rinsate samples will be collected 1/day/matrix or 1/20 environmental samples, whichever is less.

A DQA process will be followed to determine whether the type, quantity, and quality of data needed to support agency decisions has been achieved. The DQA process is used to determine whether the data meet the project DQOs. Following data validation, the DQA process involves data plotting, testing for outlying data points, and statistical hypothesis testing relative to the null and alternative hypotheses stated in the DQOs. The outcome of the DQA process is a DQA report documenting that the statistical hypothesis testing suggests that the null hypothesis is accurate, that the null hypothesis has been rejected, or that not enough data exist to make a determinative conclusion based upon the hypothesis test used. In this latter case, either additional data must be collected to support the statistical hypothesis testing or the data user must make a decision with higher uncertainty than the levels expressed in the DQOs.

As stated in the discussion of completeness, data that are not necessarily invalid may be flagged during the data validation process. Flagged data are reviewed during the DQA process to determine whether the validation flags affect the intended use of the data. The determination of whether or not flagged data are used in statistical hypothesis testing is documented in the DQA report.

Data generated in accordance with this FSP will be subject to data quality assessment in accordance with guidance for *Datu Quality* Assessment: *Practical Methods for Data Analysis* (EPA 2000b). Assumptions made in preparing this FSP and data quality objectives will be checked, including:

- Normality
- Sample size
- Spatial variability
- Whether data from different depths is from the same population.

The statistical parameters of interest will be determined based on appropriate statistical methodology. In addition, the assignment of values for non-detects will be determined during the data quality assessment process using EPA guidance (EPA 2000b). Other methods may be used for non-detects, including excluding-samples that are non-detect from the populations, which would result in a more conservative estimate of the mean concentration of the CoC at a given site.

A summary of all analytical data, limitations and validation reporting, and the data quality assessment report will be provided to the Agencies.

4.4 Data Validation

Data will be acquired, processed, and controlled prior to input to the Integrated Environmental Data Management System (IEDMS) per MCP-227, "Sampling and Analysis Process for Environmental Management Funded Activities." For the samples submitted to the analytical laboratory, all data will be categorized as "Screening data with definitive confirmation," in accordance with the QAPjP (DOE-ID 2002a).

A data limitation and validation report, including copies of chain-of-custody forms, sample results, and validation flags will be generated for each sample delivery group. All data limitation and validation reports associated with a site will be transmitted to the EPA and IDEQ within 120 days from the last day of sample collection. All definitive data will be uploaded to the IEDMS.

The analytical method data validation will be conducted in accordance with current INEEL SAM data validation procedures. Validated data are entered into the IEDMS.

5. SAMPLING PROCESS DESIGN

Specific procedures are required to handle the samples collected during the TSF-03 sampling activities to ensure that the data are representative of the soil. This section outlines the specific sampling process design for this activity. The sampling requirements discussed here will guide the collection of representative samples as specified in the DQOs (Section 4.1 of this plan). Procedures for sample collection are provided as guidelines for the field sampling team.

5.1 Presampling Meeting

Sampling procedures will be discussed each day in a presampling meeting. The meeting discussion will include, but is not limited to, sampling activities for the day, responsibilities of team members, health and safety issues, and waste management. Any deviations from the sampling strategy presented in this FSP will be documented in the field-sampling logbook.

5.2 Sample Collection

Soil samples will be collected in accordance with PRD-5030/MCP-3480, "Sampling and Analysis Process for CERCLA and D&D&D Activities." A grid will be established and sampling locations determined as specified in Section 4.1.7 of this plan.

Prior to being sampled, all sample locations will be located, staked, and clearly marked with the appropriate designations. Staked sampling locations will be surveyed in accordance with the requirements set forth in PRD-5030/MCP-3480, "Sampling and Analysis Process for CERCLA and D&D&D Activities" to establish horizontal (northing and easting coordinates) and vertical (elevation referenced to mean sea level) control. Permanent benchmarks will be used to reference the vertical control data and the horizontal grid coordinates.

Horizontal (H) and vertical (V) control will be consistent with standard third order accuracy, where:

H = 1/5,000 or 5 seconds of arc

V = 0.05 feet per M (length of loop in miles).

Field screening for gamma radiation will be performed prior to the initiation of sampling activities. The use of radiological screening instrumentation will be as determined by the HSO and the radiological control technician (RCT). Samples will be collected wherever radiological screening identifies areas of contamination above background levels. If ALs for health and safety concerns are sustained in the breathing zones, field personnel will be required to wear appropriate PPE as determined by health and safety personnel.

Grab samples will be collected from the locations identified in Figure 4-1 of this plan and will be analyzed for the constituents identified in Table 4-1. An equipment rinsate will be collected from the sampling equipment that collected the particular sample (e.g., hand auger, core barrel, stainless steel spoon). The field team members will use field guidance forms from the SAM to ensure the proper jars and preservatives are used for each analysis type.

Tables 2-1 and 2-2 in the QAPjP (DOE-ID 2002a) include identification of the container volumes, types, holding times, and preservative requirements that apply to all soil and liquid samples being collected under this FSP. Following collection, the date and time of collection, as well as the sampler's

initials, will be recorded on the sample label with a waterproof black marker. The samples will be placed in coolers with blue ice (if required) while awaiting preparation and shipment to the appropriate laboratory. Samples will be prepared and packaged in accordance with MCP-1192, "Chain-of-Custody and Sample Labeling for ER and D&D&D Projects."

5.3 Personal Protective Equipment

The PPE required for this sampling effort is discussed in the project HASP (INEEL 2003b), and may include, but is not limited to, gloves, respirators, shoe covers, and coveralls.

5.4 Shipping Screening

Prior to releasing samples collected from radioactively-contaminated areas, the RCT will field-screen all such samples for external contamination to determine whether they meet the release criteria for unrestricted use. Samples that do not meet these criteria may be submitted to the Radiation Measurements Laboratory at the Test Reactor Area for a 20-minute gamma spectrometric analysis to determine the concentration of radionuclides present and the hazardous material classification for shipping purposes. Shipping screening could be on-site using high-priority germanium, if acceptable to the hazardous materials shipper and current INEEL policy. This determination will be made by the RCT. All samples will be shipped to the laboratories by a company-certified hazardous materials shipper in accordance with PLN-120, "Hazardous Material Packaging and Transportation Quality Implementation Plan," and DOT regulations.

5.5 Field Decontamination

Field decontamination procedures are designed to prevent cross-contamination between locations and samples and prevent spread of contamination. All equipment associated with sampling will be thoroughly decontaminated prior to daily activities and between sample locations, in accordance with PRD-5030/MCP-3480, "Sampling and Analysis Process for CERCLA and D&D&D Activities." Following decontamination, sampling equipment will be wrapped in foil to prevent contamination from windblown dust.

5.6 Sampling Waste Handling and Disposition

Waste streams generated as a result of the TSF-03 sampling activities may include, but are not limited to, PPE, sample supplies and equipment, decontamination water (which may be used in small quantities during sampling), and excess or spent samples. All waste streams that are generated as a result of the sampling activities will be containerized and maintained in accordance with the project WMP (INEEL 2003a).

6. SAMPLING DESIGNATION

Samples collected in support of TSF-03 will be identified with a unique code and arranged in a SAP table and database.

6.1 Sample Identification Code

A systematic character identification (ID) code will be used to uniquely identify all samples. Uniqueness is required to maintain consistency and prevent the same ID code from being assigned to more than one sample.

The first designator of the code, 1, refers to the sample originating from WAG 1. The second and third designators, RA, refer to the sample being collected in support of the RA. The next three numbers designate the sequential sample number for the project. Regular and field duplicate samples will be designated with a two-character set (e.g., 01, 02). The last two characters refer to a particular analysis and bottle type. The SAP tables, presented in Appendix A, provide sample numbers as examples; the official sample numbers will be assigned by the SAM.

For example, a soil sample collected in support of the RA might be designated as 1RA00101R4, where (from left to right):

- 1 designates the sample as originating from WAG 1
- RA designates the sample as being collected for the remedial action
- 001 designates the sequential sample number
- 01 designates the type of sample (01 = regular, 02 = field duplicate)
- R4 designates gamma spectrometric analysis.

The IEDMS database will be used to record all pertinent information associated with each sample identification code. Preparation of the plan database and completion of the SAM request for services are used to initiate the sample and sample waste tracking activities performed by the SAM.

6.2 Sampling and Analysis Plan Table/Database

6.2.1 General

A SAP table format was developed to simplify the presentation of the sampling scheme for project personnel. The following subsections describe the information recorded in the SAP tables. A sample SAP table is presented in Appendix A.

6.2.2 Sample Description Fields

The sample description fields contain information describing individual sample characteristics.

6.2.2.1 Sampling Activity. The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (field data, analytical data, etc.) to the information in the SAP tables for data reporting, sample

traclung, and completeness reporting. The analytical laboratory will also use the sample number to track and report analytical results.

6.2.2.2 Sample Type. Data in this field will be selected from the following:

REG for a regular sample

QC for a QC sample.

6.2.2.3 Matrix. Data in this field will be selected from the following:

Soil for soil samples

Water for QA/QC samples.

6.2.2.4 Collection Type. Data in this field will be selected from the following:

GRAB for grab

COMP for composite

FBLK for field blanks

RNST for rinsates

DUP for duplicate samples.

6.2.2.5 Planned Date. This date is related to the planned sample-collection start date.

6.2.3 Sample Location Fields

This group of fields pinpoints the exact location for the sample in three-dimensional space, starting with the general AREA, narrowing the focus to an exact location geographically, and then specifying the DEPTH in the depth field.

6.2.3.1 Area. The AREA field identifies the general sample-collection area. The field should contain the standard identifier from the INEEL area being sampled. For this investigation, samples are being collected from TAN.

6.2.3.2 Location. This field LOCATION may contain geographical coordinates, x-y coordinates, building numbers, or other location identifying details, as well as program-specific information, such as a borehole or well number. Data in this field will normally be subordinated to the AREA. Samples will be collected from the TSF-03 Burn Pit area. The LOCATION field identifier will correspond to this site.

6.2.3.3 ***Type of Location.*** The TYPE OF LOCATION field supplies descriptive information concerning the exact sample location. Information is this field may overlap that in the location field, but it is intended to add detail to the location (e.g., native soil).

6.2.3.4 Depth. The DEPTH of a sample location is the distance in feet from surface level or a range in feet from the surface.

6.2.4 Analysis Type

6.2.4.1 Analysis type (AT) 1 through 20. **The ANALYSIS TYPE (AT) fields indicate analytical types (radiological, chemical, hydrological, etc.). Space necessary to clearly identify each type is provided at the** bottom **of the form. A standard abbreviation should also be provided, if possible.**

7. DOCUMENTATION MANAGEMENT AND SAMPLE CONTROL

Section 7.1 summarizes document management and sample control. Documentation includes field logbooks used to record field data and sampling procedures, photographic documentation, chain-of-custody forms, and sample container labels. Section 7.2 outlines the sample handling and discusses chain-of-custody, radioactivity screening, and sample packaging for shipment to the analytical laboratories.

7.1 Documentation

The FTL will be responsible for controlling and maintaining all field documents and records, and for ensuring that all required documents will be submitted to the ER Administrative Records and Document Control Office at the conclusion of the project.

Sample documentation, shipping, and custody procedures for this project are based on EPA-recommended procedures that emphasize careful documentation of sample collection and sample transfer. The appropriate information pertaining to each sample will be recorded in accordance with MCP-1194, "Logbook Practices for ER and D&D&D Projects," MCP-1192, "Chain-of Custody and Sample Labeling for ER and D&D&D Projects" and the QAPjP (DOE-ID 2002a). All personnel involved with handling, managing, or disposing of samples will be familiar with MCP-1193, "Handling and Shipping Samples for ER and D&D&D Projects," and all samples will be dispositioned accordingly.

A document action request (DAR) is required when field conditions dictate making any changes to this FSP (except Table 3-1), the project HASP, or other controlled project procedures (e.g., requiring additional analyses to meet appropriate WAC). If necessary, a DAR will be executed in accordance with MCP-233, "Process for Developing, Releasing, and Distributing ER Documents."

All information recorded on project field documentation (e.g., logbooks, chain-of-custody forms) will be made in permanent ink. All field documentation errors will be corrected by drawing a single line through the error and entering the correct information; all corrections will be initialed and dated. In addition, photographs will be taken to document the field sampling activities.

7.1.1 Sample Container Labels

Waterproof, gummed labels generated from the IEDMS database will display information such as the sample ID number, the name of the project, sample location, depth, and requested analysis type. In the field, label information will be completed and placed on the containers before samples are collected. Information concerning sample date, time, preservative used, field measurements of hazards, and the sampler's initials will be recorded during field sampling.

7.1.2 Field Guidance Forms

Field guidance forms, provided for each sample location, will be generated from the IEDMS database to ensure unique sample numbers. Used to facilitate sample container documentation and organization of field activities, these forms contain information regarding the following:

- Media
- Sample location
- Aliquot identification

- Analysis type
- Container size and type
- Sample preservation methods
- Field logbooks.

In accordance with the Administrative Records and Document Control format, field logbooks will be used to record information necessary to interpret the analytical data. All field logbooks will be controlled and managed according to MCP-1194, "Logbook Practices for ER and D&D&D." The FTL, or designee, will ensure by periodic inspection that the field logbooks are being maintained in accordance with this MCP. The field logbooks will be submitted to the project files at the completion of field activities.

7.1.2.1 Sample Logbooks. Sample logbooks used by the field teams will contain such information as the following:

- Physical measurements (if applicable)
- All QA/QC samples
- Shipping information (e.g., collection dates, shipping dates, cooler ID number, destination, chain-of-custody number, name of shipper).
- Meteorological data
- Other activities in the area.

7.1.2.2 Field Team Leader's Daily Logbook. A project logbook maintained by the FTL will contain a daily summary of the following:

- All team activities
- Problems encountered
- Visitors
- List of work site contacts.

This logbook will be signed and dated by the FTL or designee at the end of each day's sampling activities.

7.2 Sample Equipment and Handling

Analytical samples for laboratory analyses will be collected in pre-cleaned bottles and packaged according to American Society for Testing and Materials or EPA-recommended procedures. The QNQC samples will be included to satisfy the QA/QC requirements for the field operation as outlined in the QAPjP (DOE-ID 2002a). Qualified (Sample Management Office-approved) analytical and testing laboratories will analyze these samples.

7.2.1 Sample Equipment

Included below is a tentative list of necessary equipment and supplies. This list is as extensive as possible, but not exhaustive, and should only be used as a guide. Other equipment and supplies specified in the project-specific HASP are not included in this section. Sampling equipment that would come into contact with sample material will be cleaned prior to use employing an appropriate method (e.g., Alconox or similar nonphosphate soap with deionized water rinse, or equivalent). Field sampling and decontamination supplies may include the following:

- Drill rig capable of standard wire line coring
- Stainless-steel hand augers
- Power auger
- Tape measure [30.5 m (100 ft)]
- Wood stakes and ribbon [30.5 m (100 ft)]
- Stainless steel spoons
- Stainless steel or aluminum composting pans
- Paper wipes
- Plastic garbage bags
- De-ionized water [20 L (5.3 gal) minimum]
- Nonphosphate-based soap
- Isopropanol
- Spray bottles
- Aluminum foil
- Pipe wrench
- Crescent wrench
- Hammer
- Tables
- Certified ultra pure water [5 L (1.3 gal) JT Baker]
- Sample and shipping logbook
- FTL logbook

- Controlled copies of the FSP, QAPjP, HASP, and applicable referenced procedures
- Black ink pens
- Black ultra-fine markers
- Sample containers, as specified in the QAPjP
- Preprinted sample labels and field guidance forms
- Nitrile or latex gloves
- Leather work gloves
- Ziploc plastic bags
- Custody seals.

Sample preparation and shipping supplies include the following:

- Pipettes
- pH paper
- Nitrile or latex gloves
- Paper wipes
- Parafilm
- Clear tape
- Strapping tape
- Resealable plastic bags (such as Ziploc) in various sizes
- Chain-of-custody forms
- Shipping request forms
- Names, addresses, telephone numbers, and contact names for analytical laboratories
- Task order statements of work for analytical laboratories and associated purchase order numbers
- Vermiculite or bubble-wrap (packaging material)
- Plastic garbage bags
- Blue Ice

- Coolers
- "This Side Up" and "Fragile" labels
- Address labels
- Sample bottles and lids
- Custody seals.

7.2.2 Sample Containers

Tables 3.1 and 3.2 in the QAPjP (DOE-ID 2002a) identify container volumes, types, holding times, and preservative requirements that apply to all soil and liquid samples being collected under this FSP. All containers will be pre-cleaned (typically certified by the manufacturer) using the appropriate EPA-recommended cleaning protocols for the bottle type and sample analyses. Extra containers will be available in case of breakage, contamination, or if the need for additional samples arises. Prior to use, preprinted labels with the name of the project, sample identification number, location, depth, and requested analysis will be affixed to the sample containers.

7.2.3 Sample Preservation

Water samples will be preserved in a manner consistent with the QAPjP (DOE-ID 2002a). If cooling is required for preservation, the temperature will be checked periodically prior to shipment to certify adequate preservation for those samples that require temperatures of 4°C (39°F) for preservation. Ice chests (coolers) containing frozen, reusable ice will be used to chill samples in the field after sample collection, if required.

7.2.4 Chain-of-Custody

The chain-of-custody procedures will be followed per MCP-1192 "Chain-of-Custody and Sample Labeling for ER and D&D&D Projects" and the QAPjP (DOE-ID 2002a). Sample bottles will be stored in a secured area accessible only to the field team members.

7.2.5 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by DOT (49 CFR Parts 171 through 178) and EPA sample handling, packaging, and shipping methods (40 CFR 262). All samples will be packaged in accordance with the requirements set forth in MCP-1192 "Chain-of-Custody and Sample Labeling for ER and D&D&D Projects."

7.2.5.1 Custody Seals. Custody seals will be placed on all shipping containers to ensure that tampering or unauthorized opening will not compromise sample integrity. The seal will be attached in such a way that opening the container requires the seal to be broken. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment. Seals will be affixed to containers before the samples leave the custody of the sampling personnel.

7.2.5.2 On-Site and Off-Site Shipping. An on-site shipment is any transfer of material within the perimeter of the INEEL. Site-specific requirements for transporting samples within Site boundaries and those required by the shipping/receiving department will be followed. Shipment within the INEEL boundaries will conform to DOT requirements as stated in 49 CFX 171 through 178. Off-Site sample

shipments will be coordinated with INEEL Packaging and Transportation personnel, as necessary, and will conform to all applicable DOT requirements.

7.3 Documentation Revision Requests

Revisions to this document will follow MCP-233, "Process for Developing, Releasing, and Distributing ER Documents."

8. REFERENCES

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Appendix A

Sampling and Analysis Plan Tables

Sampling and Analysis Plan Table for Chemical and Radiological Analysis

Plan Table Number: TSF-03SOILS

SAP Number:

DRAFT

Date: 07/18/2003 Plan Table Revision: 0.0 Project: TSF-03 CONFIRMATION/VERIFICATION SOIL SAMPLING Project Manager: BRUCE, J. E. SMO Contact: KIRCHNER, D. R.

Sample Description					Planned Date	Sample Location				Enter Analysis Types (AT) and Quantity Requested																					
Sampling Activity	Sample Type	Sample Matrix	Coll Type	Sampling Method		Area	Type of Location	Location	Depth (ft)	AT1	AT2	AT3	AT4	AT5	AT6	AT7	AT8	AT9	AT10	AT11	AT12	AT13	AT14	AT15	AT16	AT17	AT18	AT19	AT20
										SC	DF	LD	PC																
T03000	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03001	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03002	REGQC	SOIL	DUP			TAN			SURFACE	2	2	2	2																
T03003	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03004	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03005	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03006	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																
T03007	REG	SOIL	GRAB			TAN			SURFACE	1	1	1	1																

The sampling activity displayed on this table represents the first six characters of the sample identification number.

The complete sample identification number (18 characters) will appear on field guidance forms and sample labels.

AT1: Chromium

AT2: Dioxins/Furans

AT3: Lead

AT4: [illegible]

AT5:

AT6:

AT7:

AT8:

AT9:

AT10:

AT11:

AT12:

AT13:

AT14:

AT15:

AT16:

AT17:

AT18:

AT19:

AT20:

Comments

Analysis Suite

Contingencies